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The invention becomes at the example of a Slab or a strip conductor laser also to each other parallel interiorcooled electrodes, which form between their each other directed flat sides a discharge space, in which a gas which can be pumped is, explained.

Slab or strip conductor lasers are for example from the EP 585,482 A1, the EP 477,864 A1 or the DE 92 17 640 U1 known. With these lasers a narrow discharge space for a gas, in particular carbon dioxide, becomes formed between to each other parallel plate shaped electrodes, which becomes excited by an high frequency voltage applied to the electrodes. The electrodes are provided with channels for a cooling medium. At the faces of the narrow discharge space formed by the electrodes resonator mirrors are disposed for obtaining a laser effect.

With these known gas lasers those becomes with pumps and due to the laser effect arising warm one over the plate shaped electrodes discharged, so that no more complicated gas circulation system is necessary. This is possible, since the electrodes are relatively wide and are relatively small their mutual spacing, which amounts to typically few millimeters. Thus a likewise relatively small between the electrodes enclosed gas volumes are in relation to the cooling surface.

Laser power output achievable with Slab or strip conductor lasers depends on the surface of the electrodes, whereby per square centimeter electrode area about 1.5 W to 2.0 W generated to become to be able. In order to be able to obtain high output powers, large-flat electrodes are required, which however due to its single heat input no more in sufficient mass parallel held to become to each other to be able. There the inner, D. h. to the gas and/or. Discharge space directed flat sides heated and the outer flat sides cooled become, the effected temperature gradient between the opposite flat sides of an electrode that the flat sides of an electrode different thermal expand. Thus develop bending moments, which cause that the electrodes at their ends exhibit a larger distance from each other than in Mitte.Die distortion of the resonator the deteriorated laser behavior caused thereby, D. h. its fashion stability and - purity. Since the deflection with increasing length of the electrodes increases, only laser power outputs of some 100 W can the thermal bend the size of the electrode areas limited be reached, there with the known lasers.

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The invention is the basis now the object to indicate electrodes for a Slab or a strip conductor laser with which can become achieved without large constructive effort a higher output power.

The object mentioned becomes dissolved, as it is ensured that the opposite flat sides 3 and 4 of an electrode 1 exhibit as same a surface temperature as possible. This becomes achieved, as the heat transfer of the single heated electrode body 1 to the cooling medium 5 single, on the wall 20 of the cooling channel or the cooling channels 11 outer of the discharge space 6 by suitable means, like for the example by targeted introduction of insulating layers 7, reduced will and/or that the heat transfer is improved by the single heated electrode body 1 to the cooling medium 5 single, on the wall 21 of the cooling channel or the cooling channels 11 of the electrode 1 directed of the discharge space 6 by suitable means, like for the example by the surface increasing measures 8 or 16, and/or that the heat transfer of the bars 9 to the cooling medium 5 by suitable means, like through for the example targeted introduction of insulating layers 19, reduced becomes. The bars 9 are material bridges, which interconnect the two flat sides 3 and 4 of the electrode 1.

An other measure, in order to realize a temperature equalizing between the two flat sides 3 and 4 of an electrode 1, is an increase of the heat flow 10 over the bars 9 of an electrode 1. This can become achieved, by for the bars 9 materials used to become, those opposite the basic material of an electrode 1 a higher thermal conductivity to exhibit and/or, as the bars of 9 cavities or capillary have, in which a medium or a vapor is, which or which by free convection current and/or by capillary action as well as by phase transitions at the walls of the cavities or capillary, warm one or latent heat of to the other side the electrode 1 transported.

All measures mentioned cause that the heat flow heats 10 from the warmer inner surface 3 to the colder outer surface 4 of the electrode 1, over the bars 9 between the cooling channels 11 also the outer surface 4 of the electrode 1 and thus the temperature gradients of the flat sides 3 and 4 to each other reduced responsible for the deflection.

The temperature gradient within an electrode 1, necessary to the heat dissipation, and the voltages connected thereby cause here ideally no deflections, if by the before described measures and by the layer of the cooling channels 11 within an electrode 1 it is ensured that the temperature distribution, is approximate symmetric related to the neutral fiber of an electrode 1. The sum of all bending moments is then ideally same zero.

It means for the practice that the effectiveness of the invention is essentially dependent from the ratio of the gate width 12 to the cooling duct-wide 13, the layer of the cooling channels 11 between the described flat sides 3 and 4, position and quality of the insulating layer 7 and/or 19, as well as on the form and the material choice of the electrode body 1 depends. As basic material for the electrode body 1 materials with good warm guidance characteristics are suitable such as copper or aluminium alloys.

In order to consider all parameters for the design of electrodes 1, are complex computations necessary, which let the use of computer simulation programs convenient appear.

The resonator mirrors 2 of a laser are an other application type of the invention, since they become interiorcooled performed in higher performance classes.

A known problem is here the absorption of a part of the laser light at the mirror surface 14, which leads to the single heating and thus to the deformation of the mirror 2. Also this leads to a distortion of the resonator and the deteriorated laser behavior. Since the deflection with increasing length of the mirror 2 increases, resonator mirrors are of it particularly 2 for Slab or strip conductor laser affected, which, elongated performed under the spatial dimensions of the discharge space 6, are narrow and. Particular problems prepare here changes of achievement during the operation of a laser, because changes of geometry of the resonator cannot be readjusted so fast.

With interiorcooled electrodes 1 and resonator mirrors 2 in accordance with Fig. 1 essential higher output powers than with can become known lasers of the same type achieved, since larger electrode and mirror surfaces are possible, which sufficient precise parallel held to become to each other to be able. Besides responsive such a laser essential more stable on changes of achievement.

Fig. the effect of the described insulating layers 7 and 19 at the walls 20 and/or 22 of the cooling channels 11 and in principle the course of the isotherms 15 shows 2 in an heat exchanger 1 or 2. The heat flow 10 over the bars 9 to the backside 4 of the heat exchanger 1 or 2 is characterized by large arrows.

Fig. in principle the course of the isotherms 15 and the deformation resultant from it shows 3 with a conventional heat exchanger. It will significant, like the heat flow over the bars, by heat dissipation to the cooling channels, blocked becomes.

Fig. 4 to 11 points examples possible variants to the design of the cooling channel or the cooling channels 11. The design of the cooling channel after Fig. 5 and 11 possible also the use of a vacuum isolation.

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1. Heat exchanger for warm one exhausting components in the pumping and/or resonator range of achievement lasers, which distort themselves by thermal stresses due to single heat input, i.e.

a) Electrodes (1) for Slab or strip conductor lasers also to each other parallel interiorcooled electrodes, which form a discharge space (6) between their each other directed flat sides (3), into a gas which can be pumped is or
b) interiorcooled resonator mirrors (2) for gas or solid state lasers, whereby the respective components (1; 2) , in whom a cooling medium (5), flowing to the heat dissipation, is, characterised in that the heat transfer of the respective component (1 contain a channel or channels (11); 2) an das Kühlmedium (5) einseitig an der von der Wärmezufuhr abgewandten Rückwand (20) des Kühlkanals oder der Kühlkanäle (11) im Verhältnis zu der ihr gegenüberliegenden Vorderwand (21) vermindert wird.

2. Heat exchanger for laser according to claim 1, characterised in that further the heat transfer of the respective component (1; 2) to the cooling medium (5), at the side walls (22) of the cooling channel or the cooling channels (11), which bars or material bridges (9) between the heat input of facing side (3) and the heat input of opposite side (4) of the respective component (1; 2) form, reduced become.

3.Wärmetauscher for lasers according to claim 1 or 2, characterised in that further the heat transfer of the respective component (1; 2) an das Kühlmedium (5) einseitig an der der Wärmezufuhr zugewandten Vorderwand (21) des Kühlkanals oder der Kühlkanäle (11) im Verhältnis zu der ihr gegenüberliegenden Rückwand (20) erhöht wird.

4. Heat exchanger for lasers according to claim 1 or 2, characterised in that the reduced heat transfer by insulating layers (7; 19) at the rear walls (20) and/or side walls (22) of the cooling channel or the cooling channels (11) by use of materials realized becomes, the one smaller heat conduction exhibits than the basic material of the component which can be cooled (1; 2).

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5.Wärmetauscher for lasers according to claim 1 or 2, characterised in that the reduced heat transfer at the rear walls (20) and/or side walls (22) of the cooling channel or the cooling channels (11) by changing the surface characteristics on chemical, physical or electrochemical path, in particular by anodising Aluminiumwerkstofffen, polishing of the surface or jobs of nanoparticles, achieved becomes.

6. Heat exchanger for lasers according to claim 1 or 2, characterised in that the reduced heat transfer at the rear walls (20) and/or side walls (22) of the cooling channel or the cooling channels (11) by use of vacuum insulating layers realized becomes.

7.Wärmetauscher for laser according to claim 3, characterised in that the cooling channel or the cooling channels (11) at that the heat input directed front wall (21) of the cooling channel or the cooling channels (11) one if possible large surface exhibit, what by grooves or waves (8) in the surface achieved becomes.

8. Heat exchanger for laser according to claim 3, characterised in that of the heat input directed front wall (21) and/or of the front part that immediate adjacent side walls (22) of the cooling channel or the cooling channels (11) ridges or arbitrary formed structures (16) into the cooling channel (11) in-rich.

9.Wärmetauscher for lasers according to claim 1 or 2, characterised in that the surface of the cooling channel or the cooling channels (11) by roundnesses (17), chamfers (18) or facets between the rear wall (20), remote of the heat input, and that immediate adjacent side walls (22) of the cooling channel or the cooling channels (11) reduced becomes.

10. Heat exchanger for lasers after one of the preceding claims, characterised in that further the heat flow (10) over bars (9) of the heat input of facing side (3) to the heat input of opposite side (4) of the respective component (1; 2) one improves.

11. Heat exchangers for laser according to claim 10, characterised in that the bars (9) or a part of the bars (9) of materials consist, which exhibit a higher thermal conductivity than the basic material of the respective component (1; 2).

12. Heat exchangers for lasers according to claim 10 or 11, characterised in that the bars (9) or a part of the bars (of 9) cavities or capillary have, in which a medium or a vapor is, which or which by free convection current and/or by capillary action as well as by phase transitions at the walls of the cavities or capillary, warm one or latent heat of the heat input of facing side (3) to the heat input of opposite side (4) of the respective component (1; 2) transported.

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